National Aeronautics and Space Administration

ARSET

Applied Remote Sensing Training

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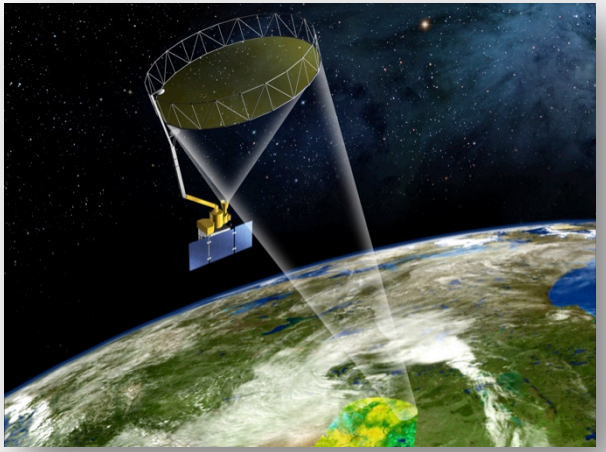
SMAP Hands-On

Jul. 20, 2016



Outline

1. Data products overview
2. Discovering and downloading the data
3. Visualizing the data
4. Analyzing the data

Data Products Overview

Data Set ID	Data Set Description	Gridding Resolution	Temporal Coverage	DAAC
SPL1AA	L1A Radar Time-Ordered Parsed Telemetry	—	4/13/15 – 7/7/15	ASF
SPL1BS0	L1B Radar Half-Orbit Time-Ordered Low-Resolution σo Data	5x30 km	4/13/15 – 7/7/15	ASF
SPL1CS0	L1C Radar Half-Orbit High-Resolution Radar σo Data	1 km	4/13/15 – 7/7/15	ASF
SPL1AP	L1A Radiometer Time-Ordered Parsed Telemetry	—	3/31/15 – present	NSIDC
SPL1BTB	L1B Radiometer Half-Orbit Time-Ordered TB	36x47 km	3/31/15 – present	NSIDC
SPL1CTB	L1C Radiometer Half-Orbit EASE-Grid TB	36 km	3/31/15 – present	NSIDC
SPL2SMA	L2 Radar Half-Orbit EASE-Grid Soil Moisture	3 km	4/13/15 – 7/7/15	NSIDC
SPL2SMP	L2 Radiometer Half-Orbit EASE-Grid Soil Moisture	36 km	3/31/15 – present	NSIDC
SPL2SMAP	L2 Radar/Radiometer Half-Orbit EASE-Grid Soil Moisture	9 km	4/13/15 – 7/7/15	NSIDC
SPL3FTA	L3 Radar N. Hemisphere Daily EASE-Grid Freeze/Thaw State	3 km	4/13/15 – 7/7/15	NSIDC
SPL3SMA	L3 Radar Global Daily EASE-Grid Soil Moisture	3 km	4/13/15 – 7/7/15	NSIDC
SPL3SMP	L3 Radiometer Global Daily EASE-Grid Soil	36 km	3/31/15 – present	NSIDC
SPL3SMAP	L3 Radar/Radiometer Global Daily EASE-Grid Soil Moisture	9 km	4/13/15 – 7/7/15	NSIDC
SPL4SMAU	L4 Global Surface & Root Zone Soil Moisture Analysis Update	9 km	3/31/15 – present	NSIDC
SPL4SMGP	L4 Global Surface & Root Zone Soil Moisture Geophysical Data	9 km	3/31/15 – present	NSIDC
SPL4CMDL	L4 Global Daily Carbon Net Ecosystem Exchange (NEE)	9 km	4/13/15 – present	NSIDC

Product Configuration

- **All products are in HDF5 format**
  - Each SMAP HDF5 file contains the primary data parameters (e.g., soil moisture, freeze/thaw, sensor data) and all data used in the production of those primary parameters. These files also include metadata, geolocation information, quality flags, etc.
- **Projection: EASE-Grid 2.0**
  - Equal-area projection
  - Level 2, 3, 4, and radiometer L1C are in this projection
- **Values**
  - Radiometer data (brightness temperature) is in Kelvin
  - Radar data is in sigma naught
  - Soil moisture is a volumetric measurement expressed as cm^3/cm^3
  - Freeze/thaw is a binary measurement, either frozen or thawed
  - Net ecosystem exchange is in grams of carbon/square meter per day

Product Configuration

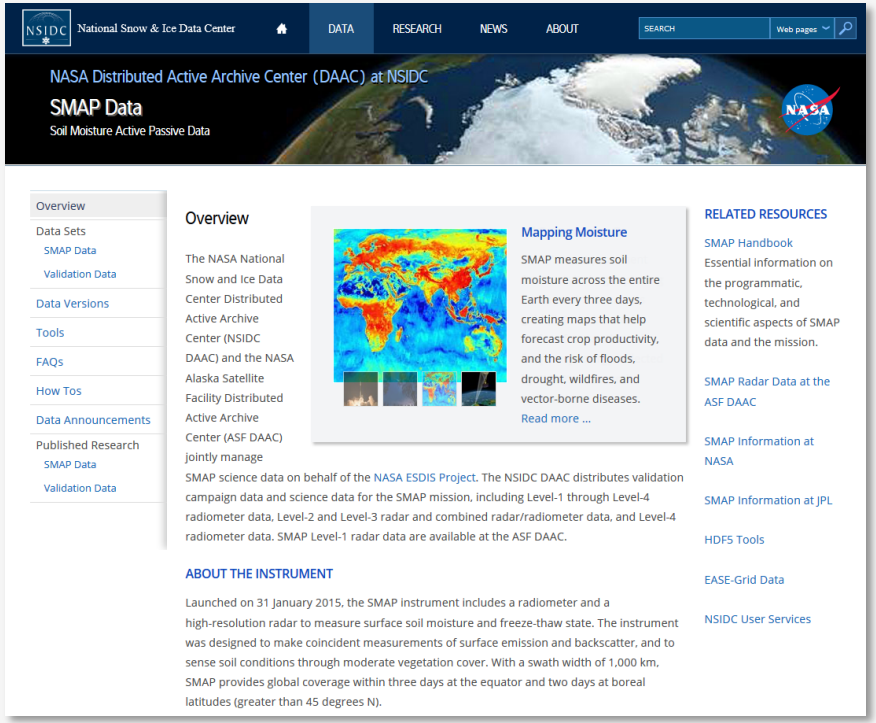
- Values
  - The radiometer data (brightness temperature) are in Kelvin
  - The radar data are in sigma naught
  - Soil moisture is volumetric and expressed as cm^3/cm^3
  - Surface freeze/thaw state is a binary measurement
  - Net carbon ecosystem exchange is in grams per square meter per day

Discovering and Downloading the Data

Data Access: NSIDC

NSIDC DAAC: http://nsidc.org/data/smap

- Access to the L1 radiometer data and all L2, L3, and L4 radiometer and radar products.
- Data access, data set user guide documents, tools, news, published research, quality information, FAQs, and many other resources.

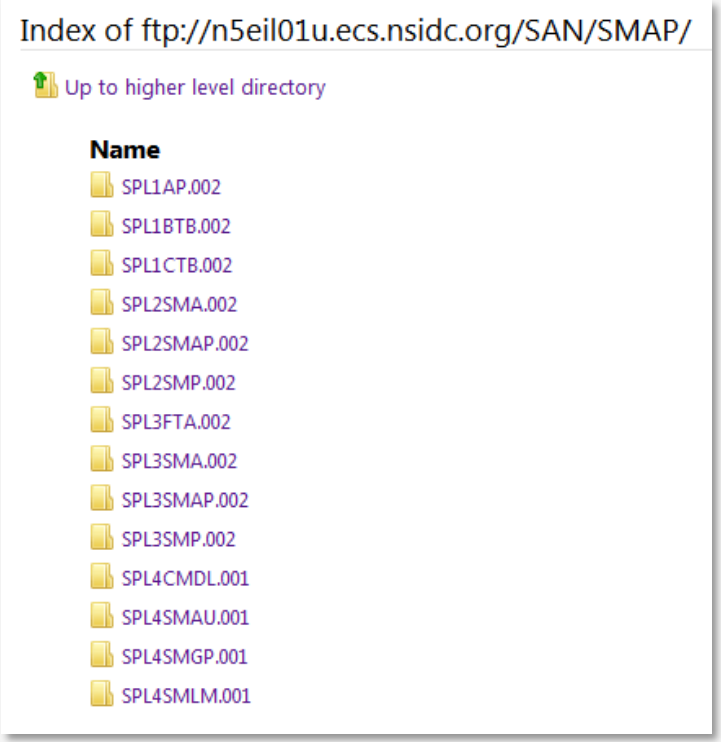


Data Access: NSIDC

NSIDC DAAC: http://nsidc.org/data/smap

- HTTPS
  - https://n5eil01u.ecs.nsidc.org/SMAP/
- FTP
  - ftp://n5eil01u.ecs.nsidc.org/SAN/SMAP

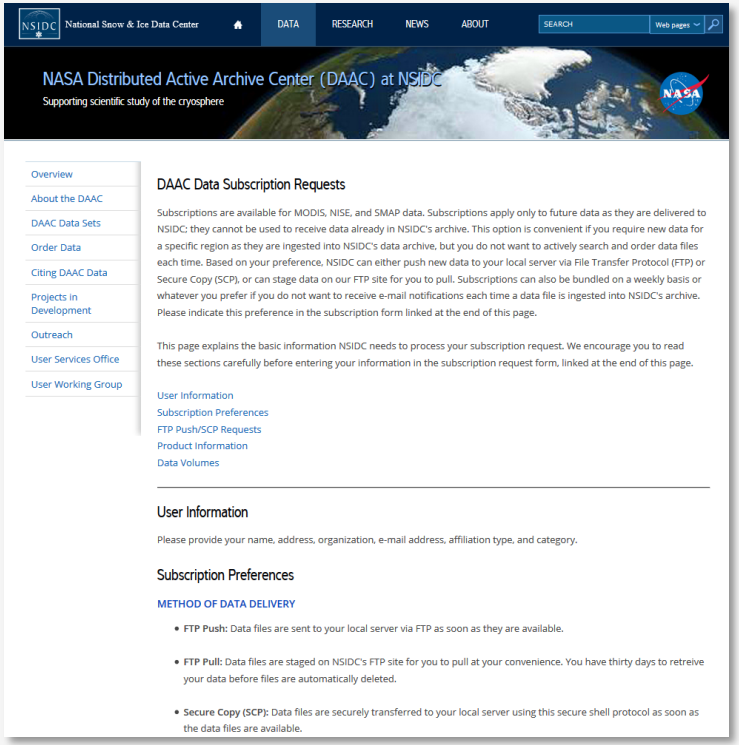
- Direct access to the SMAP data



Data Access: NSIDC

Subscription: http://nsidc.org/daac/subscriptions.html

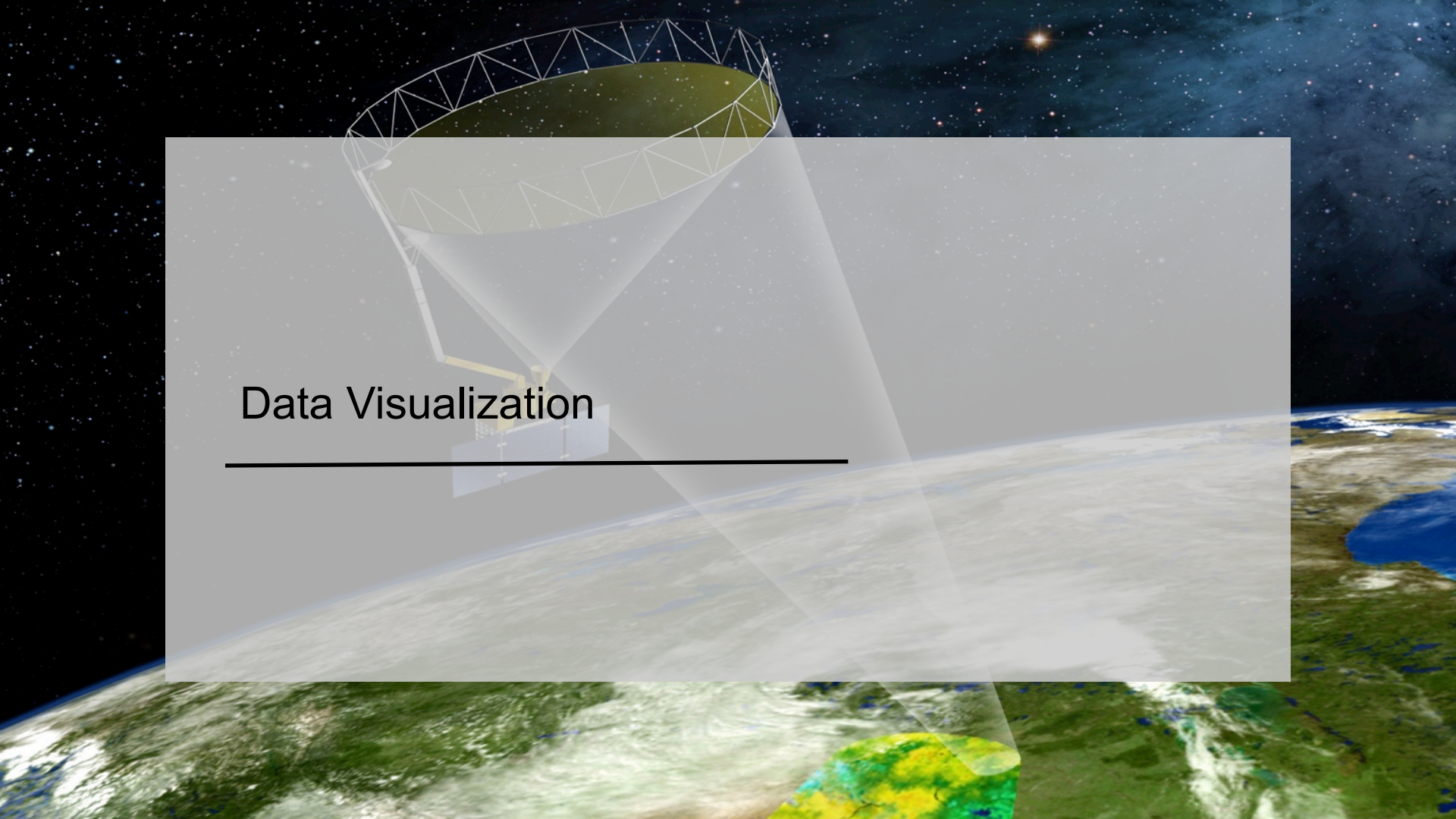
Automatic delivery of data as it becomes available.



Data Access: ASF

ASF DAAC: http://asf.alaska.edu/smap

- Access to the L1 radar data only.
- Data access, data set user guide documents, tools, news, published research, quality information, FAQs, and many other resources.

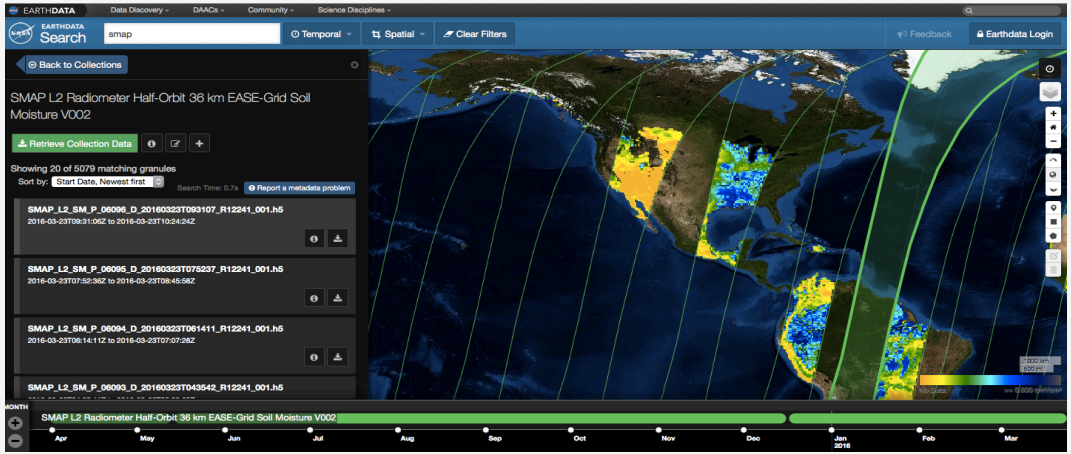

Data Visualization

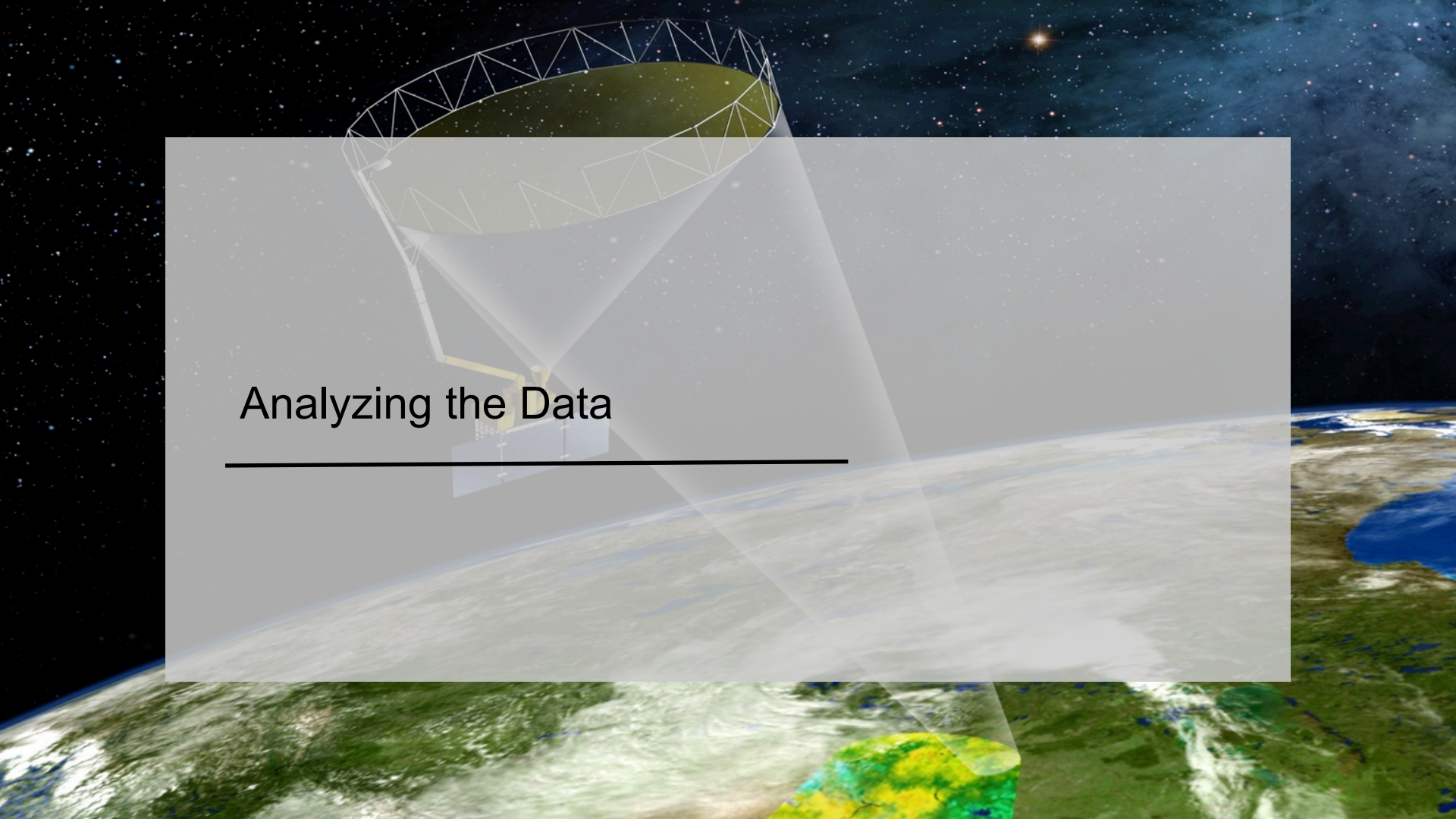
Visualizing the Data with Worldview

https://earthdata.nasa.gov/worldview

Earthdata Search: http://search.earthdata.nasa.gov/

- Search and order all SMAP data
- Keyword, spatial, and/or temporal search
- Reformat, reproject, and subset services for most products



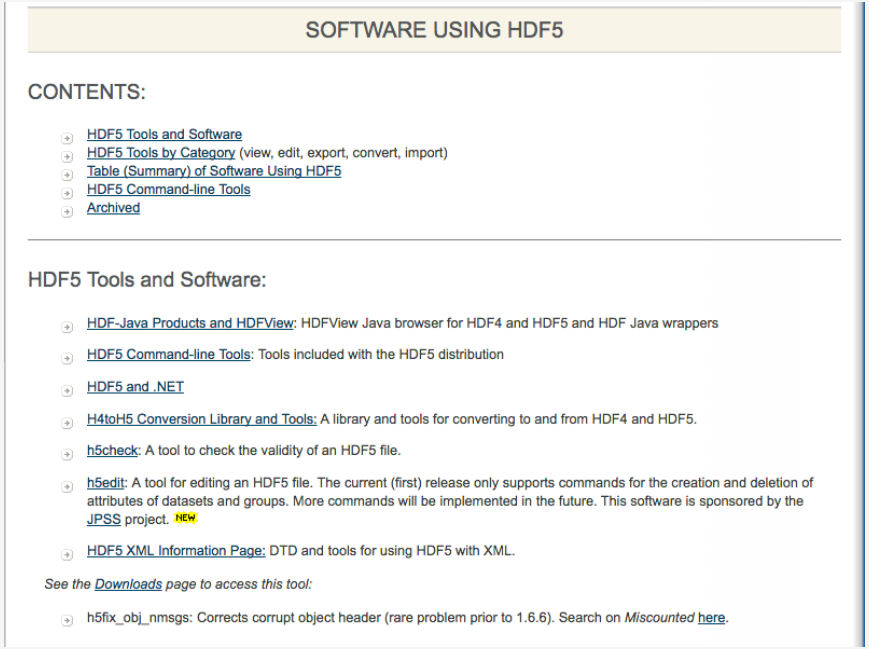


Analyzing the Data

Tools for Reading SMAP Data

- HDF5
  - http://www.hdfgroup.org/products/hdf5_tools/index.html
- Code in: Python, MATLAB, IDL, y NCL
  - http://hdfeos.org/zoo/index_openNSIDC_Examples.php#SMAP
  - Panoply

SMAP	Swath	SMAP_L1A_RADIOMETER_03721_D_20151013T000528_R11920_001.h5	Python	NCL	MATLAB	IDL
		SMAP_L1B_TB_01367_A_20150505T001706_R11850_001.h5	Python	NCL	MATLAB	IDL
		SMAP_L1C_TB_03721_D_20151013T000528_R11920_001.h5	Python	NCL	MATLAB	IDL
		SMAP_L2_SM_P_03721_D_20151013T000528_R11920_001.h5	Python	NCL	MATLAB	IDL
	Grid	SMAP_L3_SM_P_20151012_R11920_001.h5	Python	NCL	MATLAB	IDL



SOFTWARE USING HDF5

CONTENTS:

- HDF5 Tools and Software
- HDF5 Tools by Category (view, edit, export, convert, import)
- Table (Summary) of Software Using HDF5
- HDF5 Command-line Tools
- Archived

HDF5 Tools and Software:

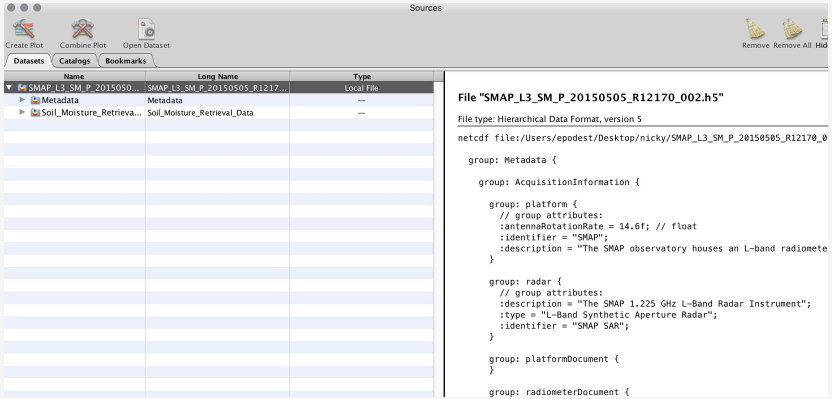
- HDF-Java Products and HDFView: HDFView Java browser for HDF4 and HDF5 and HDF Java wrappers
- HDF5 Command-line Tools: Tools included with the HDF5 distribution
- HDF5 and .NET
- H4toH5 Conversion Library and Tools: A library and tools for converting to and from HDF4 and HDF5.
- h5check: A tool to check the validity of an HDF5 file.
- h5edit: A tool for editing an HDF5 file. The current (first) release only supports commands for the creation and deletion of attributes of datasets and groups. More commands will be implemented in the future. This software is sponsored by the JPSS project. NEW.
- HDF5 XML Information Page: DTD and tools for using HDF5 with XML.

See the Downloads page to access this tool:

- h5fix_obj_nmsgs: Corrects corrupt object header (rare problem prior to 1.6.6). Search on *Miscounted* here.

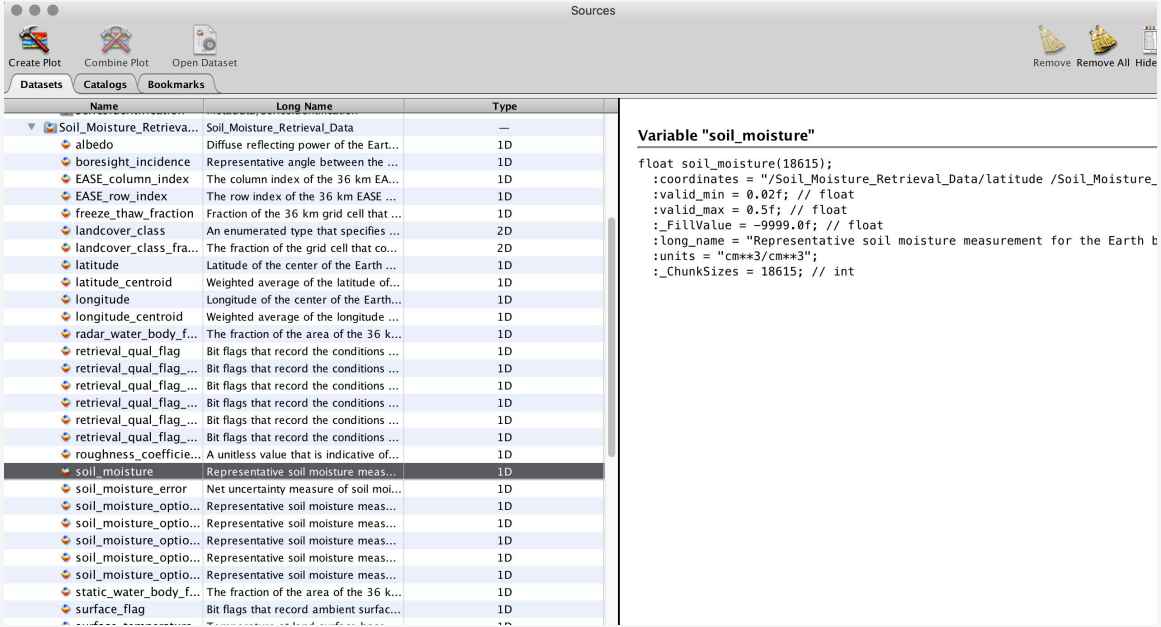
Opening a SMAP File with Panoply: L3 SM_P

1. Open Panoply
2. Go to File-Open and open your file
3. “SMAP_L3_SM_P_20150505_R12170_002.h5” The left window shows the archive structure, which has two folders: Metadata and Soil Moisture
4. Double click on an archive to see the files within it.



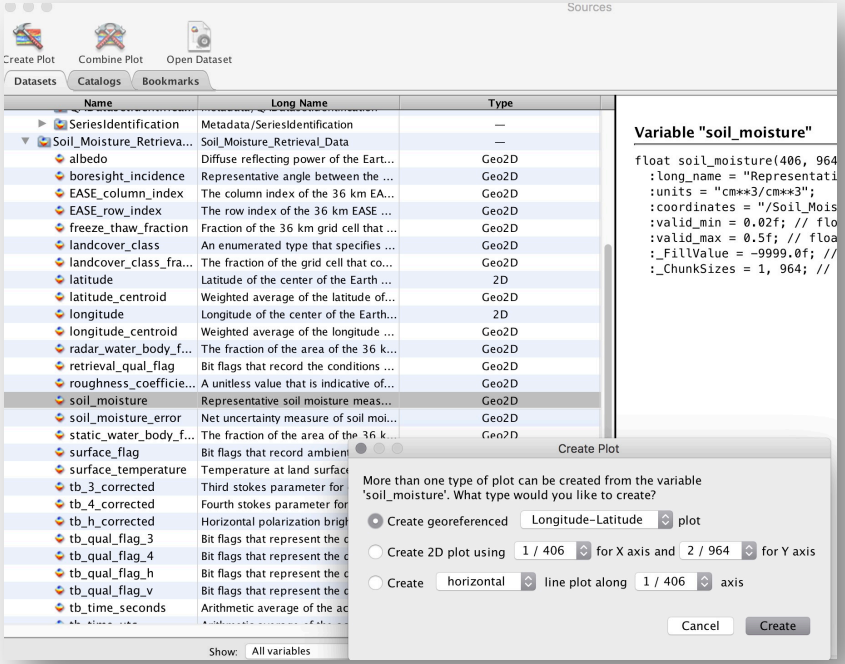
Opening a SMAP File with Panoply: L3 SM_P

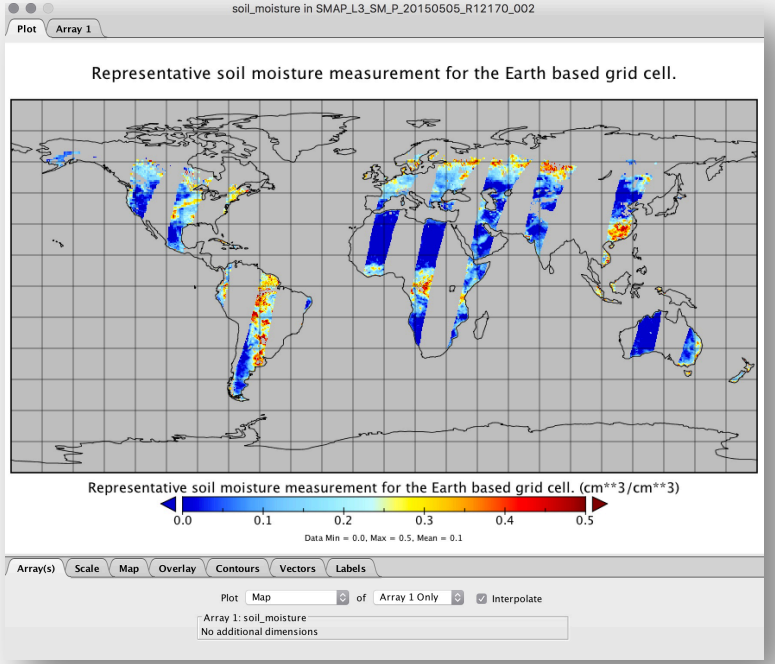
5. Click on soil moisture to see the characteristics or metadata of the file in the right window.



Opening a SMAP File with Panoply: L3 SM_P

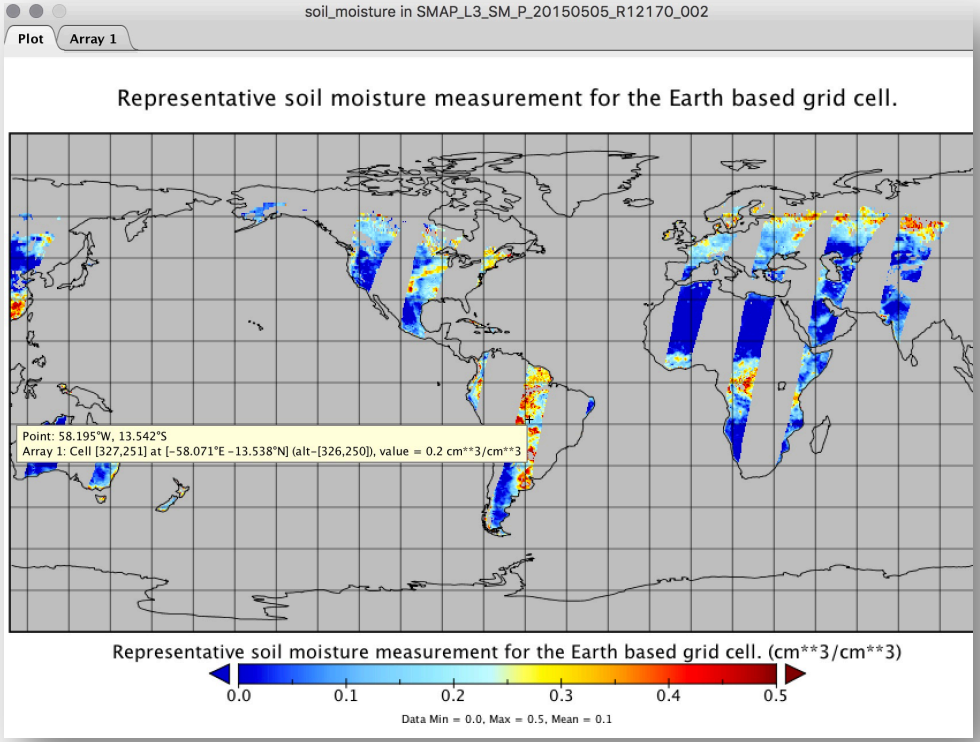
6. Open the file as a map by double clicking on the soil moisture file





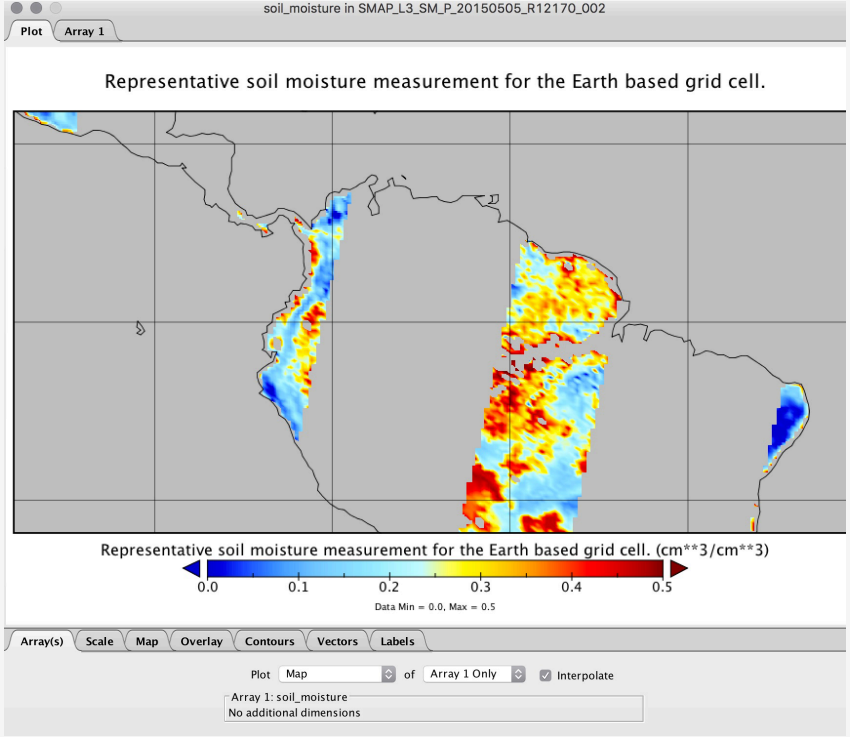
Displaying the Pixel Value on the Map: L3 SM_P

7. To see the pixel value place the cursor over the point of interest and click “Alt”



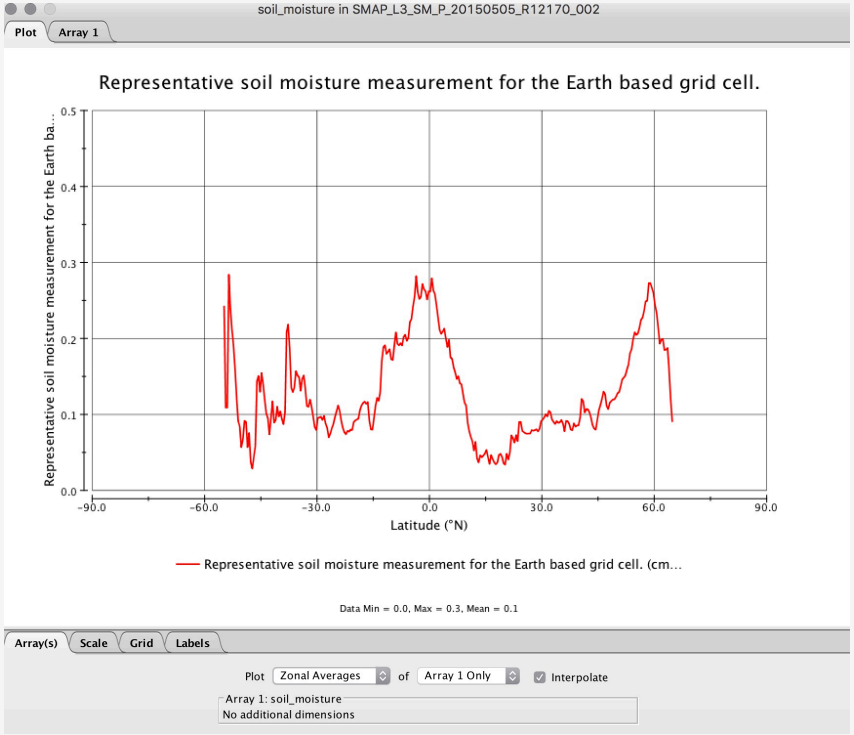
Zooming into the Image: L3 SM_P

8. To zoom into an area go to the top menu and select “Plot-Zoom In”



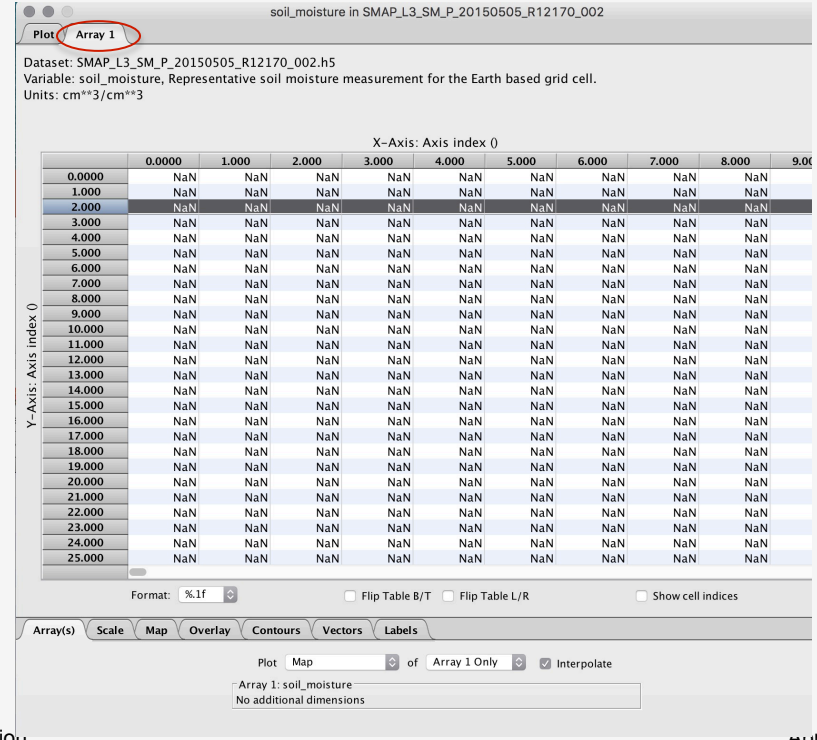
Plotting the Data: L3 SM_P

9. In the lower window select “Array-Plot” to create a plot of soil moisture as a function of latitude



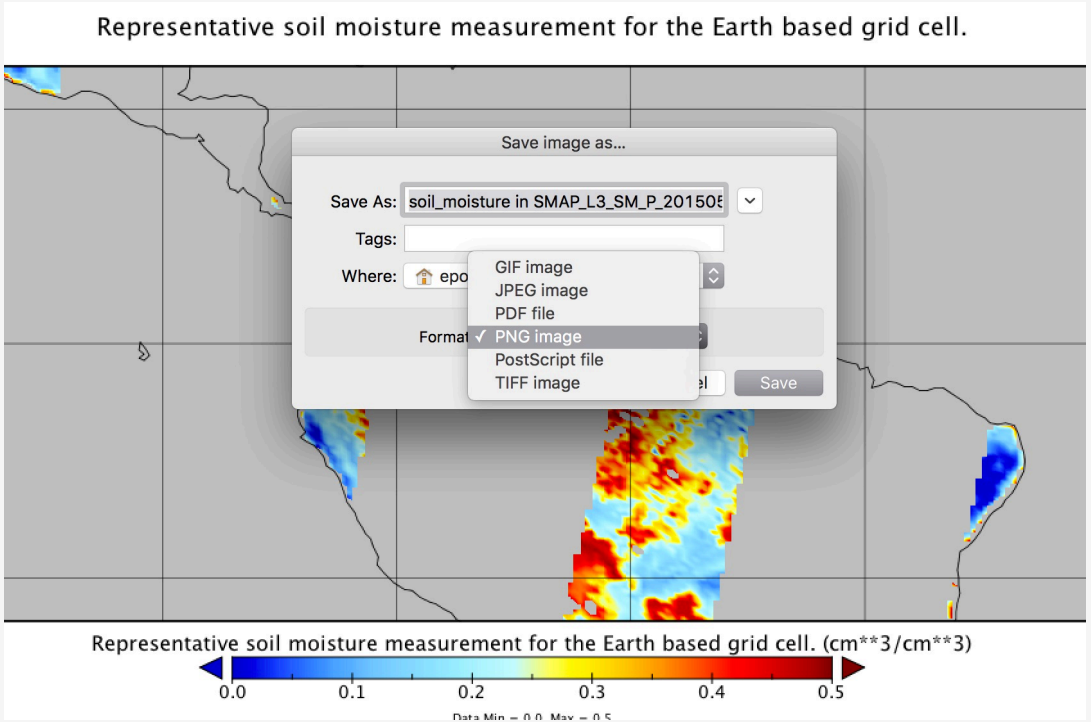
The File Values: L3 SM_P

10. Click on the tab option on the top that says “Array” in order to see the values in the file



Saving a File: L3 SM_P

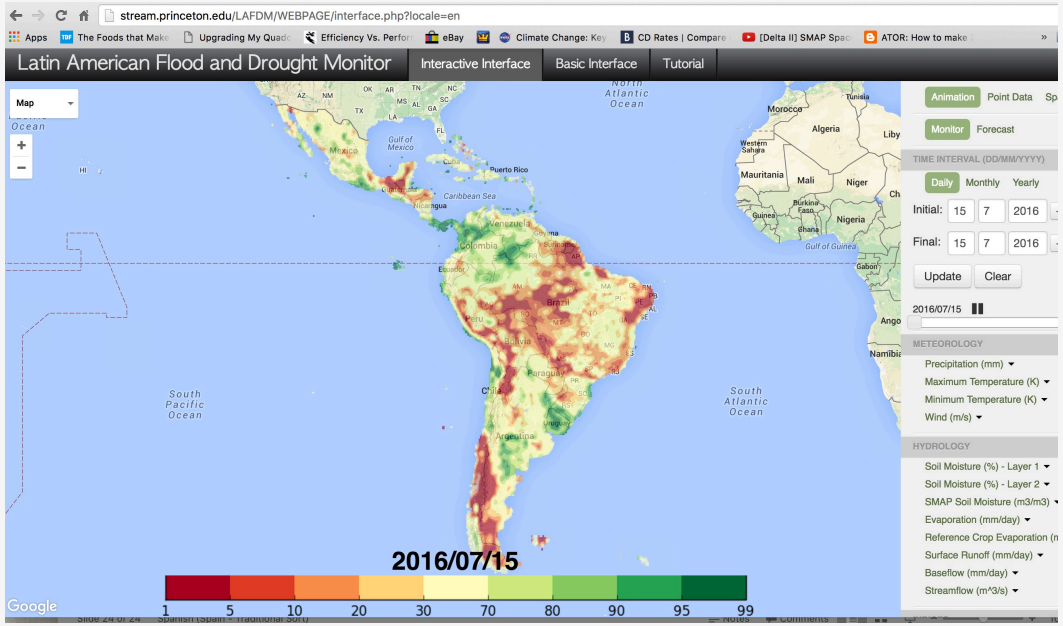
11. To save a file in a different format (e.g. Png, tiff, pdf) select ”File-Save Image As” from the main menu



Extracting SMAP Soil Moisture

12. The most direct way to extract SMAP soil moisture values is using the ”Latin American Flood and Drought Monitor” tool from Princeton University:

http://stream.princeton.edu/LAFDM/WEBPAGE/interface.php?locale=en



Extracting SMAP Soil Moisture Values

13. To extract soil moisture values from SMAP:

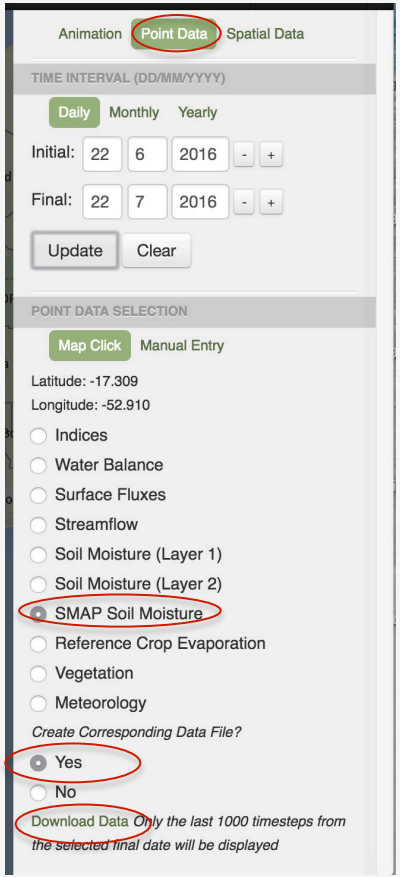
-in the upper right window select “Point Data”.

-in the next section under “Time Interval” specify the period of interest that you would like soil moisture. Note that SMAP soil moisture data is available as of mid-April 2015.

-in the next section select ”SMAP soil moisture” and click on the map over your point of interest or manually specify your lat/lon using the “Manual Entry” option.

-in the last part under “Create Corresponding Data File” select “yes”

-Click on “Download Data” at the very bottom



Extracting SMAP Soil Moisture Values

14. The data are downloaded directly to your computer as a text file

```
year,month,day,SMAP Soil Moisture - 1 day composite (m3/m3)
2016,6,22,-999.000
2016,6,23,0.110
2016,6,24,-999.000
2016,6,25,-999.000
2016,6,26,0.119
2016,6,27,-999.000
2016,6,28,-999.000
2016,6,29,0.123
2016,6,30,-999.000
2016,7,1,0.112
2016,7,2,-999.000
2016,7,3,-999.000
2016,7,4,0.120
2016,7,5,-999.000
2016,7,6,-999.000
2016,7,7,0.097
2016,7,8,-999.000
2016,7,9,0.112
2016,7,10,-999.000
2016,7,11,-999.000
2016,7,12,0.111
2016,7,13,-999.000
2016,7,14,-999.000
2016,7,15,-999.000
2016,7,16,-999.000
2016,7,17,-999.000
2016,7,18,-999.000
```

Exercise

15. From the same page download SMAP soil moisture data as well as vegetation and/or meteorological data for the same point. Plot them and explore correlations.